

CHAPTER 3

OPERATION AND TESTING OF THE GAC 2100 MOISTURE METER

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3.1 MAINTENANCE

Meters must be maintained in good operating condition. Check them prior to initial use and periodically thereafter, as needed. Each maintenance check shall include the following:

- a. Environmental Conditions. Ensure that the moisture meter is placed in a room that is within the manufacturer's basic requirements of 10-40 EC (50-104 EF). To minimize the effects of instrument temperature in official inspection, it is recommended that the laboratory temperature for the GAC 2100 be maintained within the range of 15-30 EC (approx. 60-85 EF).
- b. Cell Cleaning.
 - (1) Display the DIAGNOSTICS MENU (Option 6 of the TESTS MENU). When the DIAGNOSTICS MENU displays, depress the LOAD key. The hopper doors open and will remain open until the UNLOAD key is depressed. Use the brush supplied in the accessory kit to clean the inside of the grain cell. Take care not to bump the sensing diodes.
 - (2) Slide the GAC 2100 to the front of the worktable and remove the grain drawer. Reach up inside and very carefully clean the strike-off arm spring. Clean excessive dust off of the window and other surfaces.
 - (3) Depress the UNLOAD key. The cell rotates 180 degrees to dump the residue from the cell cleaning procedure. The hopper doors close. Depressing PREVIOUS PAGE key twice returns the display to the MAIN MENU.
- c. Fuse Replacement. Replace the fuse only if necessary. Disconnect the power cord from the rear of the unit. Using a small screwdriver or similar tool, remove the cover and fuse block assembly. Replace the fuse with a 0.4 amp Slo-Blo type fuse. Replace the fuse block and cover.

- d. Electrical connections. Check the condition of the power cord and connections, and ensure that a grounded plug is used. Non-GIPSA personnel are cautioned that when using an adapter with a grounding wire, make sure the grounding wire is connected properly to a good earth ground, otherwise a shock hazard could be present. GIPSA personnel shall not use adapters. Also, failure to use a properly grounded outlet could cause moisture accuracy problems.
- e. Security. Security of the calibrations and other parameters affecting measurement accuracy must be ensured.
 - (1) Sealing. The access port on the rear (lower left side) of the unit shall be sealed to prevent access by unauthorized personnel. (All meters, regardless of their location.)
 - (2) Security Codes.
 - (a) Operator Level. No access code required.
 - (b) The Access Code Level is the basic security level. All modifications can be performed except those dealing with official calibrations, output options, and clearing of the audit memory. Actions are recorded in the audit trail.
 - (c) The User ID Code Level is the top security level. All modifications are allowed. Actions are recorded in the audit trail.
 - (3) Audit Trail Printing. Printing of the audit memory can be initiated by depressing the **(5)** key from the CALIBRATION MENU. A screen appears instructing you to press PRINT to begin. Depress the PRINT key. If only the header, current date, current time, and serial number print during this process, the audit memory is empty. Any entries under these headings indicate that changes have been made.
 - (4) Clearing Audit Trail. Authorized personnel only. Before clearing the audit trail, print and save the paper copy in the file with meter test records.
 - (5) Audit Trail Event Counter Display. The total number of changes to the audit memory can be displayed. From the MAIN MENU, select **(5)** TESTS MENU, and **(5)** DISPLAY. Four numbers appear at the bottom of the display. The third number (from left to right) is the total number of audit memory changes made to the instrument--the audit trail event count.

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- (6) Moisture Meter Record Log. A permanent log book shall be established and maintained for each GAC 2100. The book shall be kept with the meter at the official use site. The log will be used as an important historical record to indicate:
- (a) Serial Number.
 - (b) Meter test dates, results, and comments.
 - (c) Date and type of each repair.
 - (d) Date and location for each transfer to a new site.
 - (e) Date seal applied (number and initials).
 - (f) Date and initials for each entry or change of calibration constants (both official and unofficial).
 - (g) Date, time, and initials when recording the results of an audit trail event count.
 - (h) Date, time, and initials when checking seals, calibrations, etc., following return from cross utilization.
 - (i) Other historical information.

Figure 3.1,
Log Book Example

DATE	ACTION	NAME OF PERSON MAKING ENTRY
7-8-98	Rec'd SN 4999 from Dickey John	JR
7-10-98	Checked calibrations for CORN, HIGH Moist CORN, SOYBEANS, & SUNFLOWER SEED, per Directive 9180.61	PH
7-10-98	Applied Seal FG 5321	JR
7-21-98	Tested & Approved by ISE	PH
7-22-98	Moved to XY2 ELEVATOR Beaumont, TX	PH

3.2 OPERATION

- a. Cross-utilized Equipment. When moisture meters are used by both official agency and unofficial (elevator) personnel, the elevator shall not make any changes to the meter set-up, unless approved and witnessed by the official agency. When a meter has been out of official agency control, the official agency shall check the operation of the meter before commencing daily operations. This should include a weighing test, security seal check, and printing of the audit trail. If problems are found, remove the unit from official service until corrected.
 - (1) As an alternative to printing the audit trail, the official agency may display and record the audit trail event count in order to verify that no changes have been made.
 - (2) Another alternative is to display the calibration constants and verify their correctness. An official list of calibration constants must be used.
 - (3) Whatever method of security check is performed, it must be recorded in the log book and the entry initialed.
- b. Current date and time shall be set.
- c. Test Weight per Bushel. This function is not approved for official use.
- d. Power-up and Grain Selection. When the power is turned on, the unit automatically begins a self-check to determine the status of the (1) load/strike-off mechanism; (2) unload function; (3) empty test cell weight; and (4) conductance/ capacitance measurement circuitry. The MAIN MENU (the “Home” screen through which all other screens are accessed) appears immediately after all start-up checks are successfully completed. Allow approximately 15 minutes of warm-up time before taking official moisture measurements. Press the (2) key to access the CALIBRATION MENU, then select the type of grain to be measured.
- e. Recording Results. The GAC 2100 does not require manual calculations or the reading of charts, therefore eliminating the use of a moisture log. Official personnel will maintain a work record on the pan ticket and certificate.
- f. Instrument Temperature. The built-in GAC 2100 instrument temperature range limit is 10-40 EC (50-104 EF). If the instrument temperature is determined to be outside the range of 10-40 EC, no moisture results will be displayed.

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To minimize the effects of instrument temperature in official inspection, it is recommended that the laboratory temperature for the GAC 2100 be maintained within the range of 15-30 EC (approximately 60-85 EF). (Same as for Model 919.)

- g. Sample Temperature. The built-in GAC 2100 sample temperature range limit is 0-40 EC (32-104 EF). If the instrument's measured sample temperature is outside the range of 0-40 EC, no moisture results will be displayed.

For optimum accuracy and consistency in official inspection, it is recommended that the sample temperature be brought within the range of 10-32 EC (50-90 EF) before performing moisture determinations.

- h. Sample-Instrument Temperature Difference. The built-in GAC 2100 sample-to-instrument temperature difference limit is 20 EC (36 EF). If the instrument finds the sample temperature to be different from the instrument temperature by more than 20 EC, it will not display moisture results.

For optimum accuracy and consistency in official inspection, it is recommended that the difference between the grain and instrument temperature not exceed 11 EC (20 EF). (Same as for model 919).

- i. Sample requirement. Pour the sample through the divider at least once (to mix the sample) before filling the hopper. The GAC 2100 does not require weighing a portion size.
- j. Handle all cold samples quickly to reduce the possibility of condensation in a warm room. Samples on which snow or ice has melted or which contain snow or ice, are unsuitable for moisture testing.
- k. Keep all samples in sealed moistureproof containers if they cannot be tested within approximately 15 minutes.
- l. Do not use paper bags, fiber cartons, or similar containers that allow moisture losses. Use metal cans, plastic containers, and plastic bags to preserve the sample integrity. Do not file samples with paper identification inserted in the grain. Paper absorbs moisture and lowers the moisture of the grain.

- m. When obtaining a portion for moisture testing, ensure that the sample has passed through the Boerner divider at least once (to mix the sample). If you obtain the moisture portion from the file or work sample by pouring or scooping, return the moisture portion to the file or work sample after testing to maintain the representativeness of the sample for other tests.
- n. Normal Warm-up. Samples should remain in the area where tests are to be made until the grain reaches a temperature within the established limits. Place the containers on a table in such a manner as to allow free access of air to all sides. Placing the containers on a wire grating or rack has the additional advantage of exposing the bottom as well as the sides of the containers to the air. Temperature equalization may be hastened by frequent shaking of the containers or by directing an electric fan at the cans.
- o. Quick Warm-up.
 - (1) Cut the sample down to the appropriate size for a moisture test (about 350 grams). Use of an excessively large sample will cause the warming process to be slower.
 - (2) Place the sample in a zipper-closure type 1-gallon storage bag (1.75 mil thick polyethylene). (Hefty OneZip® bags were found to be particularly convenient for this process.)
 - (3) Flatten the bag and squeeze out as much air as possible. Then close the bag.



- (4) Put the closed bag on a wire rack positioned at least 2 inches from any surface and directly in the air flow of a fan blowing room-temperature air. Air flow must be brisk on top and bottom sides of the bag. The fan should have a minimum blade diameter of 12 inches and should be run on medium to high

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speed. Flatten the bag and smooth out the grain sample so that it is essentially one kernel thick. Leave the flattened, closed bag on the rack for three (3) minutes. (The time may need to be adjusted, depending on grain and laboratory temperatures.)

- (5) This process should warm a 42 EF corn or soybean sample to about 60 EF in 3 minutes if the laboratory temperature is above 70 EF. For best accuracy, the grain should be warmed to above 50 EF. If the initial grain temperature is lower than 40 EF or the laboratory temperature is below 70 EF, the grain may need to remain on the rack for more than 3 minutes to reach a final temperature of 50 EF or greater. Also, as noted above, using a excessively large grain sample, failing to exclude air from the bag before closing, or failing to spread the grain out to a thin layer within the bag will slow the warming process.
- p. Pour the grain into the sample hopper. Fill the sample hopper located on top of the unit with enough grain to fill the measuring cell inside the instrument (heap grain slightly). The exact volume of grain is not important, except enough grain must be present to overfill the cell (approximately one pint). When the test begins, any excess grain spills over the cell and drops into the sample drawer. If the amount of grain is insufficient to overfill the test cell, depress UNLOAD to dump the sample and repeat the test with a sufficient sample size.
- q. Depress the LOAD key on the keyboard to start the test cycle.
- r. Wait briefly for the moisture test to finish.
- s. Observe the results of the test on the display.

- t. The GAC 2100 is equipped to report moisture outside the approved range for the calibration. An error indication will notify the operator if the calibration range is exceeded. When the moisture reading exceeds the approved calibration range, another determination shall be made from the work sample or file. If the second determination is not outside the approved calibration range, use the second moisture result. Otherwise, the final moisture shall be based on the average of the two determinations and rounded to the nearest 0.1 percent moisture.
- u. When finished with the measurement, depress the UNLOAD key.
- v. For additional instructions, refer to the GAC 2100 operator's manual.

3.3 HEADQUARTERS STANDARD METERS

- a. GIPSA Headquarters shall maintain four Standard meters, three of which are kept in service as working Standard units. The remaining meter is a back-up unit, ready to be placed into service if one of the three Standard meters fails. All Headquarters Standard units must pass the acceptance test and, subsequently, the regularly scheduled maintenance tests.
- b. Acceptance Test (for new/repared Standard units). Conduct duplicate direct comparison tests among two of the manufacturer's Standard meters and each new or repaired Headquarters Standard meter. Average the moisture results of the duplicate tests. Each new or repaired Headquarters Standard meter must meet the tolerances below. (To avoid unnecessarily transporting the manufacturer's Standard meters, a repaired meter may be tested in duplicate at the factory, transported by a technical specialist to TSD, and tested in duplicate against the remaining three Standard units.)

Conduct duplicate direct comparison tests among the three working Headquarters Standards and the new or repaired Standard meter. Average the moisture results of the duplicate tests. Each new or repaired Headquarters Standard meter must meet the tolerances below.

- c. Maintenance Tests. Once every two months, perform a direct comparison test among the Headquarters Standards. Each Headquarters Standard meter must meet the tolerances below.

Once a year, conduct a direct comparison test among two of the manufacturer's Standard meters and the Headquarters Standard meters. Each Standard meter must meet the tolerances below.

Test Tolerances for Headquarters Standard Meters		
<u>Diagnostic Self Test</u>	<u>Weight Test Deviation</u> (g)	<u>Maximum Moisture Test Deviation</u> <u>Direct Comparison</u> (%)
SCD1 = 379 ± 5	Average ± 0.5	Average ± 0.05
SCD2 = 2500 ± 5	Range # 0.5	Range # 0.25

Figure 3.2, Tolerances for Standards

If a Standard meter fails to meet one of the above specifications, the entire test may be repeated and the results of the two tests averaged to obtain the final result. Accuracy of test results is contingent on the manufacturer maintaining its Standards in a manner acceptable to TSD.

- d. Daily Continuity Check.
 - (1) Obtain a sample of dockage-free HRW wheat in the range of 11.0-12.0 percent moisture. Store the sample in a moisture proof container at the instrument site. Once a day during data collection, obtain a moisture reading on each data collection meter using the designated sample. Record the results in an instrument log book. After two weeks, calculate the average of the daily readings for each portion. Compare subsequent daily check results against the average to determine if any meter is drifting.
 - (2) Some gradual drift is expected due to moisture loss over time. Recalculate the average every month to maintain a current baseline value. If a meter deviates more than 0.3 percent moisture from its current average, obtain a second reading to verify the drift. If drifting is evident, check the meter against the other Headquarters Standard meters according to the maintenance test, above. If the meter fails the test, remove it from service, until repaired.

3.4 TESTING OFFICIAL MOISTURE METERS

The instrument shall be warmed up for at least 30 minutes before performing parts a., b., and c., below. Before proceeding to part d., the instrument and sealed sample shall be allowed to equilibrate to the temperature of the room for at least four hours.

a. Verify Calibration Constants.

- (1) Record the location information on the data sheet.
- (2) From the MAIN MENU, press **(3)** CALIBRATION MENU, **(1)** VIEW CALIBRATION, **(5)** HRW.
- (3) Verify the issue date and values for K1 through K9. These values should agree with the official calibration constants list. Initial in the space provided.
- (4) Press PAGE BACK to the SELECT GRAIN TO VIEW menu and repeat verification of K1 through K9 for all other grains having official calibrations.
- (5) Press PAGE BACK to the MAIN MENU.

b. Verify Diagnostic Test Values.

- (1) Record the instrument serial number on the data sheet.
- (2) From the MAIN MENU, press **(5)** TESTS MENU, **(6)** DIAGNOSTICS, **(5)** SCD1.
- (3) Record values for SCD1 and SCD2.
- (4) SCD1 should be within the range 379 ± 7 .
- (5) SCD2 should be within the range 2500 ± 7 .
- (6) Press PAGE BACK to the MAIN MENU.

c. Verify accuracy of the weighing system. This test can be performed by the operator any time the instrument's accuracy is questioned. It must be performed immediately prior to conducting the moisture sample comparison test (part d., below).

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- (1) Clean out the sample drawer, striker arm, and cell area to remove any material that may be lodged in crevasses.
- (2) From the MAIN MENU, press **(5)** TESTS MENU, **(7)** TEST NETWORK MODE.
- (3) Pour 350-400 grams of a room temperature, medium moisture (approximately 10-12 percent), clean soybean sample into the sample hopper. The soybeans should have an official test weight of at least 55 pounds per bushel.
- (4) Press the LOAD key to start the measurement.
- (5) Wait until the measurement is completed. Do not unload the cell yet.
- (6) Record the D3 value. Divide by 10 to get the weight in grams and round to the nearest 0.1 gram. Record on the data sheet.
- (7) Empty all of the overflow grain from the sample drawer. Replace the sample drawer.
- (8) Press the UNLOAD key to dump the grain from the test cell into the sample drawer.
- (9) Carefully pour the grain from the sample drawer into a tared weighing pan (capture all grain that was in the test cell), weigh the grain using an approved and tested electronic grain test scale, and record the weight of the grain to the nearest 0.1 gram. This is a precise weight measurement. Be careful to minimize air currents around the grain test scale.
- (10) Calculate and record the difference between the GAC weight and the grain test scale weight.
- (11) Recombine the measured sample and the overflow portion and repeat steps 3 through 10 four more times, for a total of five determinations.
- (12) Average the differences. The average of the five differences should not exceed ± 1.0 gram.

- (13) The range of the five differences should not exceed 1.0 gram.
- (14) Press PAGE BACK to the MAIN MENU.
- d. Verify performance with grain moisture sample.
 - (1) From the MAIN MENU press **(5)** TESTS MENU, **(8)** PARAMETERS MENU, **(4)** VIEW CALIBRATION ADJUSTMENT CONSTANT.
 - (2) Record the instrument calibration adjustment constant (CAC) and sample I.D. number on the data sheet.
 - (3) Clean out the sample drawer, striker arm, and cell area to remove any material that may be lodged in crevasses.
 - (4) From the MAIN MENU press **(2)** SELECT GRAIN, **(5)** WHEAT HRW.
 - (5) Pour the entire check sample into the sample hopper. The weight of the sample is not critical, so it is allowable for a few kernels to remain in the can.
 - (6) Press the LOAD key to start the measurement.
 - (7) When the moisture measurement is displayed, record it on the data sheet.
 - (8) Press the NEXT PAGE key to see the D-values. Record the values for D1, D2, D3, and D4.
 - (9) Press the UNLOAD key to dump grain from the test cell into the sample drawer.
 - (10) Repeat steps 5 through 9 five more times, for a total of six determinations.
 - (11) Place the sample back into the original container and close it tightly. Retain the sample for possible retest until TSD validates the test.
 - (12) Record the name of the field meter operator and date of test on the data sheet.
 - (13) Fax the data sheet to TSD at (816) 891-8070.

Test Tolerances for Meters (Other than Headquarters Standards)			
<u>Diagnostic Self Test</u>	<u>Weight Test Deviation</u> (g)	<u>Maximum Moisture Test Deviation</u>	
		<u>Direct Comparison</u> (%)	<u>Sample Exchange</u> (%)
SCD1 = 379 ± 7	Average ± 1.0	N/A	Average ± 0.15
SCD2 = 2500 ± 7	Range # 1.0	N/A	Range N/A

Figure 3.3, Tolerances for Official Meters

- (14) TSD will enter the data into a spreadsheet and compare the results to the tolerance. The D-values are important because they provide the means to calculate moisture results to a greater precision and to determine possible causes for out-of-tolerance results.
- (15) The tolerance for moisture meters is ± 0.15 percent mean deviation from Standard meter, when testing by sample exchange using Hard Red Winter wheat in the range of 11.0 to 12.5 percent moisture.
- (16) TSD will fax the completed data sheet showing the test results to the official agency and field office. If results are out-of-tolerance, TSD will advise whether to retest the sample or seek instrument repair.
- (17) If the sample is to be retested, repeat steps 1 through 13. TSD will retest the sample after it is returned.
- (18) Return the moisture sample to:

TSD-ISE-Moisture
 USDA-GIPSA-FGIS Technical Center
 10383 N. Executive Hills Blvd.
 Kansas City, MO 64153-1394

3.5 REPAIR OF GIPSA-OWNED MOISTURE METERS

- a. General. All repairs to GIPSA-owned meters shall be made by the manufacturer. Field offices shall not attempt to make repairs or adjustments other than as outlined in this handbook or the GAC 2100 operator's manual.
- b. Moisture meter users should consult with TSD and the manufacturer (1-800-637-3302) to determine the need for maintenance and repair of malfunctioning meters. "Loaner" moisture meters are available from the manufacturer.
- c. To aid the manufacturer in determining the types of repairs needed, thoroughly describe the malfunction or operational difficulty, and provide any other pertinent information concerning the condition of the meter.
- d. Before packing the meter for shipment be sure to engage the shipping brace in the "transport position."
- e. Upon return, the meter shall be tested against a Headquarters Standard meter before authorization of payment (if necessary) and official use.

Reserved

Figure 3.4, Form FGIS-923, "Moisture Meter Test"

Part A
 Part B
 Part C
 Part D

		U.S. DEPARTMENT OF AGRICULTURE Grain Inspection, Packers & Stockyards Administration Moisture Meter Test		FORM APPROVED OMB NO. 0580-0013 File Name: _____	
Field Office _____ Agency _____ Location _____ Phone _____ Fax _____				<input type="checkbox"/> INITIAL <input type="checkbox"/> RETEST <input type="checkbox"/> REPAIR <input type="checkbox"/> 2ND SAMPLE	
PARTS A. AND B. CALIBRATION CONSTANTS & DIAGNOSTIC VALUES VERIFICATION					
VERIFIED K1 THRU K9 : Initials _____					
METER S/N		SCD1		SCD2	
PART C. WEIGHING ACCURACY TEST					
	DROP 1	DROP 2	DROP 3	DROP 4	DROP 5
D3 VALUE	1	5	→		
D3 / 10 ROUND TO 0.1	2				
SCALE WEIGHT (g)	3				
GAC WT - SCALE WEIGHT	4				
AVG OF DIFFERENCES		RANGE OF DIFFERENCES			
6		7			
PART D. GRAIN MOISTURE SAMPLE TEST					
METER CAC	1	SAMPLE I.D.	2		
	DROP 1	DROP 2	DROP 3	DROP 4	DROP 5
DISPLAY MOISTURE	3	5	→		
D1	4				
D2					
D3					
D4					
CALC. MOISTURE					
AVG MOISTURE					
STD. AVG. MOISTURE					
DEVIATION		OPERATOR (FIELD):	6	DATE TESTED:	7
TOLERANCE	0.15	REVIEWER (HQ):		DATE REVIEWED:	
RECOMMENDED ACTION: APPROVED <input type="checkbox"/> RETEST <input type="checkbox"/> REPAIR <input type="checkbox"/>					
COMMENTS					
Public reporting burden for this collection of information is estimated to average 0.083 hours per response and 0.001 hours of record keeping, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send Comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Department of Agriculture, OIRM, AG Box 7630, Washington, D.C. 20250; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, D.C.					

Form FGIS 923 (9-98)

Instructions for Completing
Form FGIS-923, "Moisture Meter Test"

Fill in any missing or incorrect information in the Identification Block.

Part A.

Verify all official calibration constants. Update all obsolete calibrations. Initial to indicate that all calibrations are correct.

Part B.

Enter meter serial number.

Enter SCD1 and SCD2 values.

Part C.

1. Enter the result of the first drop (the D3 value).
2. Divide the D3 reading by 10. Record the result to 0.1
3. Enter the weight reading from the lab scale.
4. Enter the difference (Item 2 minus Item 3).
5. Repeat Item 1 through Item 4 for a total of five drops.
6. Enter the average difference (average of five differences from Item 4).
7. Enter the range of differences (total spread of the differences).

Part D.

1. Enter the CAC from the meter display (not from records).
2. Enter the grain sample identification.
3. Enter the moisture display for the first drop.
4. Enter the values D1, D2, D3, and D4 for the first drop.
5. Repeat Items 3 and 4 for a total of six drops.

6. Enter the name of the field test meter operator.
7. Enter the date.

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